

**OVERVIEW OF THE  
TOGIAK HERRING SAC ROE AND SPAWN-ON-KELP FISHERIES  
BRISTOL BAY, ALASKA**

**REPORT TO THE ALASKA  
BOARD OF FISHERIES**



By  
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## INTRODUCTION

The Bristol Bay area includes all waters south of a line extending west from Cape Newenham, east of the International Date Line in the Bering Sea and north of a line extending west from Cape Menshikof. The Bristol Bay area is divided into three herring fishing districts: General District; including all waters west of the longitude of Cape Newenham, Bay District; including all waters east of the longitude of Cape Constantine and the Togiak District; including all waters between the longitude of Cape Newenham and the longitude of Cape Constantine. The Togiak District spans approximately 192 km (Figure 1). Togiak village lies at the center of the district, 108 km west of Dillingham.

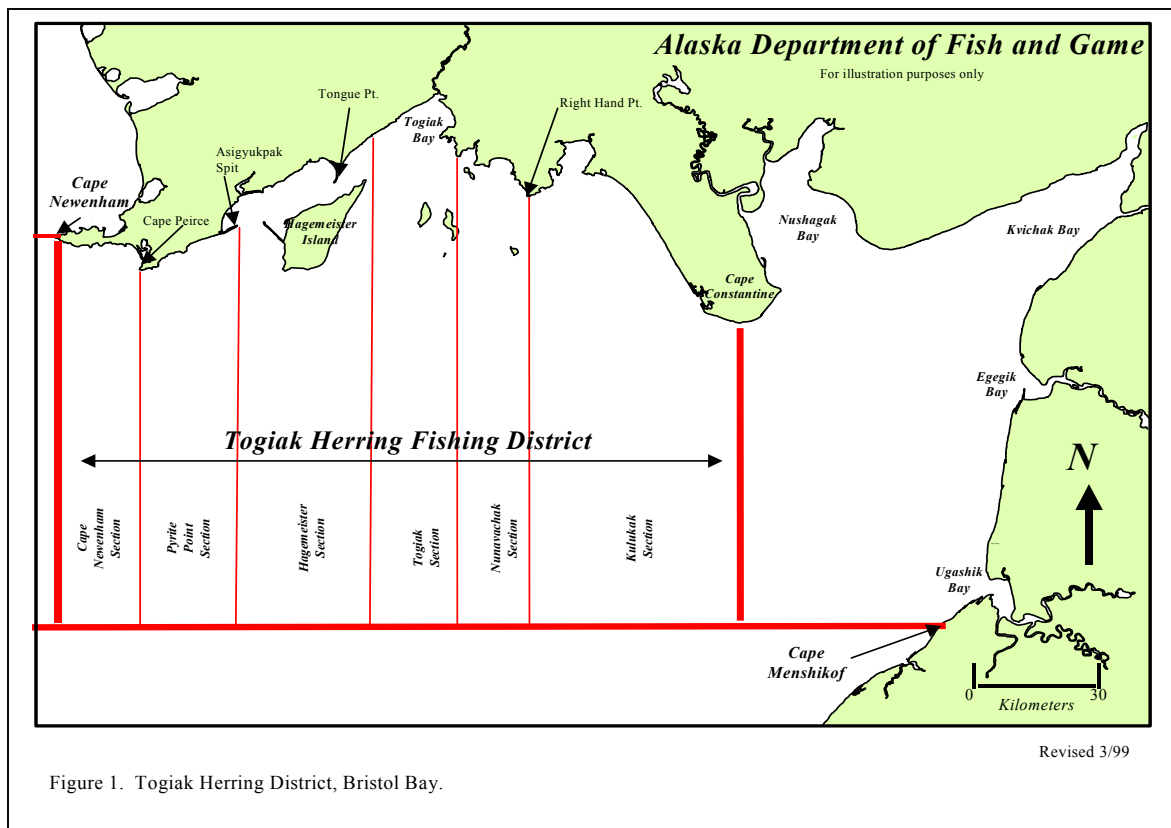


Figure 1. Togiak Herring District, Bristol Bay

Pacific herring (*Clupea pallasii*) have been documented throughout Bristol Bay, but the major concentration returns to the Togiak area each spring and is the focus of herring sac roe and spawn-on-kelp fisheries. In the Togiak District, herring are commercially harvested for sac roe using gillnets and purse seines. Herring generally spawn on rockweed kelp (*Fucus spp.*), which is harvested by hand and/or rake.

The herring sac roe fishery began in Togiak District in 1967, followed by the first fishery for spawn on kelp in 1968. Effort and harvest levels remained low for the first 10 years of the fishery. Increased interest, favorable market conditions and additional incentives provided by the Fishery Conservation and Management Act of 1976 (the 200-mile limit) resulted in a rapid expansion of the Togiak herring fishery in 1977.

The Togiak herring fishery is the largest herring fishery in Alaska. Sac roe harvests since 1984 average over 20,000 tons, worth \$7.5 million annually. Spawn-on-kelp harvests since 1984 average over 346,000 lbs. (including only the years when a fishery occurred), worth about \$288,000 to fishers. In 2003, exvessel value for sac roe harvests was higher than the previous year but was the second lowest since 1979 (Appendix Table 1).

This report summarizes the Togiak herring stock assessment program, reviews the Togiak District herring fisheries from 1984 through 2003 and presents projections for the 2004 herring season.

## **STOCK ASSESSMENT**

### **Methods**

Since 1984, the Alaska Department of Fish and Game has conducted aerial surveys throughout the spawning season to estimate abundance, timing, and distribution of Pacific herring in the Togiak District. Surveys are conducted regularly from approximately April 15 until June 1 each year. Once herring are observed, surveys are conducted daily (weather permitting) until biomass declines and spawning activity subsides.

Aerial survey techniques used in Togiak have remained largely unchanged since 1978 and are described in Lebida and Whitmore (1985). Herring school surface area is estimated through a handheld tube with a measured grid and a known focal length from a known altitude. Standard conversion factors of 1.52 tons (water depths of 16 ft or less), 2.58 tons (water depths between 16 and 26 ft) and 2.83 tons (water depths greater than 26 ft) per 538 ft<sup>2</sup> of surface area is applied to herring school surface areas to estimate the total biomass observed during each flight.

Volunteer test fisheries, originally implemented by the department to estimate roe quality, provide samples for age, size and sex composition analysis. Samples are also collected from commercial harvest for age composition and size analysis. After the season, results are used to revise biomass estimates.

### **Spawning Population**

Since 1978, herring were generally first observed in the district in early May, but were observed entering near shore areas as early as April 19 and as late as May 20. Biomass increased rapidly and peaked within one to seven days of the first observation in all but four years. In recent years, biomass declined rapidly following the peak observation, but herring continued to enter and exit

the district for several weeks. For all but nine years, spawn was first observed any time within three days of the first herring observation. Similar to trends observed for biomass, spawning in all but two years accelerated rapidly, peaked from one to four days after the first occurrence of spawn, and then rapidly subsided. Small “spot” spawns have been observed as late as June 7.

Annual estimates of the Togiak herring biomass range from 69,000 tons observed in 1980 to 239,000 tons documented in 1979 (Appendix Table 2). Abundance appeared to be high in the late 1970's, declined in the mid 1980's and remained relatively low and stable through 1991. Observed biomass levels increased to a peak of 194,000 tons in 1993 (Appendix Table 2.)

Most recently, during the winter of 2002-2003, climatic conditions were abnormally warm; there was very little snowfall in southwestern Alaska and the ground was virtually snow free by the time of the first survey on April 16. The Bering Sea ice pack had receded north of Cape Newenham by mid-March, and there were large areas of 4° C. water in the Bering Sea. A cold snap from mid-March to early April cooled water temperatures and created some ice in the near shore waters. By mid-April, the temperature had increased again and there was no ice observed during the first survey. These factors indicated an early arrival of herring in the Togiak District, but managers were unsure how early that arrival might be. A temperature model based on April mean air temperatures from Cape Newenham, and used by the department to predict spawning timing for Togiak herring projected the first spawn of one mile or greater would occur on April 29.

Aerial surveys of the Togiak District began April 16, 2003. Herring were first documented in the district on the afternoon of April 19, when approximately 100 tons of herring were observed at the northeast tip of Hagemeister Island. Herring were seen in the same location on the following day and were then observed in Ungalikthluk Bay on April 21. The first spawn was observed on April 23 in Ungalikthluk and Togiak Bays, but a complete survey was not possible because of heavy fog covering most of the district. In the few areas where visibility was good, 1,600 tons of herring and 0.6 miles of spawn were observed. Weather prevented a survey on April 24. Department staff deployed to the field office at Togiak Fisheries shoreplant on April 25.

Two aerial surveys were conducted on April 25. Weather and water conditions were poor for both surveys but 19,000 tons of herring were documented during the first survey and 10,000 tons during the second. Additionally, over 6 miles of spawn were documented. Although the threshold biomass of 35,000 tons of herring was not documented due to poor survey conditions, managers stipulated that the threshold biomass was present and commercial fishing could proceed based on the length of time that herring had been on the grounds (7 days), combined with the amount of spawn that had been documented (6+ miles).

The 2003 herring run was forecasted to be 126,213 tons. Prolonged poor weather during the latter portion of the season prevented staff to reliably estimate a total run biomass from aerial surveys. Samples to estimate the age structure of the 2003 biomass were taken from purse seine landings and can be separated as follows: 31% age 5-6, 28% age 7-8, and 41% age 9+. At this time, the status of the Togiak herring stock is considered stable.

## **SAC ROE HERRING FISHERY**

### **Fishing and Industry Participation**

Unlike most herring fisheries in Alaska, the Togiak sac roe fishery is not a limited entry fishery. Gillnets, purse seines and hand purse seines are legal gear.

Since fishing effort is not limited, effort levels can vary substantially each year. Herring market conditions are one of the leading factors influencing effort in a given year, but other factors also influence fleet size. Since the majority of herring permit holders in Togiak participate in other fisheries like Bristol Bay salmon, the health of the salmon market and markets for other fish indirectly affect effort in the herring fishery. Herring prices paid to permit holders the prior year and run timing also affect effort. In the last three years processors have developed cooperative fleets for the purse seine fishery. Processors in conjunction with the coop members exclude entrants into the fishery. This is beginning to happen in the gillnet fleet as well.

Fishing effort in the sac roe fishery increased through the late 1980's, decreased early in the early 1990's, then increased again to a peak in 1996 and has declined since 1997 (Appendix Table 3). Gillnet effort increased to 300 vessels in 1989, declined to a low of 75 vessels in 1993, and then peaked in 1996 with 461 vessels and has since declined to a low in 2003 of 75. Purse seine effort increased steadily from 1978 through 1989, when 310 vessels were observed. From 1990 to 1997, the purse seine fleet has fluctuated between 200 and 300 vessels, and has declined to less than 100 vessels since 1998. In 2003, the total number of purse seines was 35, an all-time low.

Reduction in fleet size has led to the development of cooperative seine fisheries that focus on fish with high quality roe rather than on quantity. Reduced fleet size has led to changes in the way the fishery is managed; because fishing is less aggressive, managers can allow 12 hour openings leading to increased selectivity and smaller sets.

Industry participation in the fishery peaked between 1979 and 1982, when 33 processors participated in the herring fishery. From 1987 through 1997, 16 to 22 companies have purchased herring or spawn on kelp in Togiak. Over the past 6 years, industry participation has steadily declined to a low in 2003 of 7 companies. Processing capacity on the grounds has also declined from a high of 4,850 tons per day in 1996 to a low in 2003 of 1,920 tons per day.

### **Gear Specifications**

The Alaska Board of Fisheries has reduced gear to limit harvesting capacity and control problems with waste. Prior to 1989, gillnet length was restricted to 150 fathoms. Each permit holder was restricted to the use of one legal limit of gear, but up to 300 fathoms could be operated from a fishing vessel. Under these gear allowances, lost and abandoned nets accounted for substantial amounts of waste during some years. In 1989, the Board reduced the legal compliment of gillnet gear to a maximum of 100 fathoms in length per permit holder, restricted the operation from one vessel to 100 fathoms, and granted the department the authority to reduce



length to 50 fathoms in season. The Board transposed this regulation in 1992 when it restricted herring gillnet length to 50 fathoms but granted the department the ability to allow up to 100 fathoms of gear by emergency order. This change enabled the department to maintain an orderly fishery, helping ensure roe quality and minimizing potential waste. Gillnet depth remains unrestricted.

In October of 1989, the Board reduced purse seines to 100 fathoms in length and 16 fathoms in depth. In 1995, the Board further restricted purse seine depth to 625 meshes, of which 600 could be no larger than one and one-half inches. Depth was reduced in 1995 to control harvesting capacity. Adjustments in allowable gear have appeared to control waste and preserve order in the fishery without a substantial reduction in harvesting capacity.

## **Harvests and Management Performance**

### **Exploitation**

The commercial sac roe and spawn-on-kelp harvests in the Togiak District have been regulated by emergency order since 1981. From 1981 through 1987, informal policies directed the department to ensure that minimum threshold biomass levels were observed before opening the herring fishery, and to manage the fishery so that exploitation did not exceed 20%. In 1988, the Board incorporated the threshold and exploitation rate policies into the Bering Sea Herring Fishery Management Plan (5 AAC 27.060) for Togiak and other Bering Sea fisheries. Herring biomass in Togiak has been estimated at levels well above threshold requirements since 1981.

Including the 1978 season, actual exploitation rates have exceeded 20% in 5 of 26 years (Appendix Table 4). Although the spawn-on-kelp and Dutch Harbor food and bait fisheries conduct harvests on Togiak herring, only sac roe harvests were used in calculating exploitation rates from 1981-1983. Estimates for herring equivalent of spawn-on-kelp harvests and harvest in the Dutch Harbor fishery were not included in the exploitation figure until 1984 and 1988 respectively. Exploitation in the past five years has fallen below 20%, this is mainly a result of changes in fleet size, harvest strategy and the absence of spawn-on-kelp harvest (in 2 of the 5 years).

### **Sac Roe Allocation**

Herring sac roe purse seine and gillnet harvests are managed for allocation guidelines set forth in the Bristol Bay Herring Management Plan (BBHMP) (5 AAC 27.865) originally adopted by the Alaska Board of Fisheries in late 1980. In 1980, the regulations were set forth to “try to insure that neither gear group is totally disadvantaged.” The regulation required that “when harvest reached 20,000 metric tons, if one gear type has less than 6,000 tons, the other gear type will close for 24 hours.” In 1982 and in 1985, the regulations were modified to include adjustments based on fishing time rather than tonnage so that the ratio of time for gillnets and seines was 3:1 (1982) or 5:1 (1985). In 1988, the issue of allocation was examined by the BOF again and a new plan was set forth. This plan stated that, before opening the sac roe fishery, 1,500 short tons

must be set aside for the spawn-on-kelp fishery, and 7% of the remaining available harvest is allocated to the Dutch Harbor food and bait fishery. After the spawn-on-kelp and the Dutch Harbor harvests are subtracted, the remaining harvestable surplus is allocated to the Togiak sac roe fishery: 25% to the gillnet fleet, and 75% to the purse seine fleet (Table 2, Appendix Table 5). In 2001, allocation issues were addressed again by the BOF and harvest percentages were modified to 70% purse seine and 30% gillnet. The Board also clarified that management action was to be taken inseason to achieve the specified ratio. In 2002, with 2,500 tons of the quota remaining, the purse seine fleet could no longer find marketable size herring to harvest. Because the purse seine fleet was unable to continue fishing and the allocation was at the 70/30 ratio, the gillnet fleet was also closed even though there was still marketable quality herring available to the gillnet fleet and they had quota remaining.

To achieve the gillnet and purse seine allocations, the department calculated guideline harvest levels (tons) each year by apportioning 30% and 70% of the sac roe allocation to each gear, respectively. The department then regulated fishing time and area to achieve each guideline harvest level, while maintaining a 30/70 ratio. In 2003, the available harvest of herring was allocated as follows:

Spawn on Kelp- 1,500 tons  
Dutch Harbor Food and Bait- 1,662 tons<sup>a</sup>  
Togiak Sac Roe- 22,081  
Purse Seine (70%)- 15,457  
Gillnet (30%)- 6,624 tons

<sup>a</sup>(the amount taken in 2002 was over the GHF and was subtracted from the harvest for this year leaving 442 tons)

Table 1: Summary of Performance 2001-2003.

	2001			2002			2003		
	Harvest	Effort	Processors	Harvest	Effort	Processors	Harvest	Effort	Processors
Purse seine	15,320	64	11	11,833	37	8	15,158	35	7
Gillnet	6,481	96	11	5,216	82	8	6,505	75	7
Exvessel	\$3,090			\$1,880			\$2,660		

## Product Quality and Value

The Board of Fisheries has directed the department to give product quality and fishery value an equal priority with exploitation objectives. Management Guidelines for Commercial Herring Sac Roe Fisheries (5 AAC 27.059) state the department may manage sac roe fisheries to enhance product value by opening areas in which sampling has demonstrated high herring roe content and large herring size, and to minimize harvest of recruit size herring. The BBHMP also states that the primary objective in the sac roe fishery is to prosecute an orderly, manageable fishery while striving for the highest level of product quality and a minimum of waste. Given these regulations

and comments from industry, the department considers maximizing quality and value to be primary objectives in the Togiak fishery.

The department used volunteer test fishing as a means to maximize harvest roe quality since 1982. Test fishing procedures developed and became more intensive from 1982 through 1989. By 1990, the department had established standard test fishing areas and sample sizes, coordinated test fishing start times between areas, coordinated and assisted in transporting samples to roe technicians and established criteria required to open an area. Since then, the department has opened to commercial fishing only areas that have documented high quality roe.

Development of test fishing procedure sped the availability of results, reduced time required between test fishing and opening an area to commercial fishing, and helped ensure high roe quality in harvests. Average mature roe percentage increased from a ten-year average of 9.45% (1984-1993) to 10.04% (1994-2003). However, average mature roe for the last three years declined to 9.96%.

As an indirect result of recent test fishing procedures, gillnet harvest area was gradually reduced in the late 1980's and early 1990's due to lack of successful test fishing or poor quality results in some areas of the district. From 1994 through 1997, gillnet fishing was opened almost exclusively in the area between Right Hand Point and Kulukak Bay. This reduction in area heightened competition among the gillnet fleet, especially during 1996 and 1997, when fishing effort was high. Since 1997, attempts have been made by management staff to spread gillnet harvest out to include areas west of Right Hand Point. However, it has proven difficult to dislodge the gillnet fleet from the protected anchorage of Metervik Bay not only to participate in test fisheries but even to fish in a commercial gillnet period.

Although average mature roe for gillnets has increased from 8.57% (1984-1993) to 11.4% (1994-2003), purse seine average mature roe has decreased from 9.69% (1984-1993) to 9.4% (1994-2003). Gillnet-caught herring quality rose sharply in 1993 and has remained high since 1993. Although some of this difference may be attributed to management efforts, most is due to an apparent shift to larger gillnet mesh sizes. Prior to 1993, gillnets with mesh sizes smaller than three inches (stretched) were common. Gillnets with 3-inch mesh and larger have since become standard gear. This shift to large-mesh gillnets appears to have increased the percentage of female herring caught by herring gillnets from 46.3% (1984-1993) to 58.5% (1994-2003).

In 1992, over 20,000 tons of herring were harvested by purse seines in one 20-minute period. This magnitude of harvest from a single opening, combined with a limited processing capacity, resulted in holding times up to seven days, and large-scale deterioration of flesh and roe quality. The poor product quality resulting from the 1992 harvest and increasing market demands for high quality roe, compelled the department to recognize quality problems associated with extended holding times of longer than 3 days. Limiting individual harvests not to exceed 3 days of processing capabilities became a management objective after 1992.

From 1992 until 2000 the department limited harvests by carefully controlling the open area and duration of each purse seine opening. Since 2000, the fishery has become much more self regulating in that processors have smaller fleets and are much more restrictive about how long

they will hold herring before processing. The reduced processing capacity makes it impossible for the whole quota to be processed in less than ten days. In the 2003 herring fishery, there were nine 12-hour openings to begin the season. Then, with less than 2000 tons remaining on the quota, the department had two 1-hour openings and a final 10-minute opening. The 110 hours and 10 minutes total fishing time for the purse seine fleet in 2003 contrasts with the 20-minute opening in 1992.

## **SPAWN ON KELP FISHERY**

Like the sac roe fishery, the spawn on kelp harvest in the Togiak District has been regulated by emergency order since 1981. Since 1984, the spawn on kelp fishery was managed under the direction of the Togiak District Herring Spawn on Kelp Management Plan (5 AAC 27.834). The plan essentially provides for an allocation of 350,000 lbs of product, equivalent to 1,500 tons of herring, to this fishery. The plan also directs the department to 1) rotate harvest areas on a two to three year basis (Figure 2), 2) ensure product quality, and 3) include the herring equivalent to the spawn on kelp harvest when calculating exploitation.

Fishing effort in the spawn on kelp fishery increased steadily since its inception, and peaked at 532 participants in 1991 (Appendix Table 6). The fishery became limited to interim use and permanent permit holders in 1990. Following the 1991 season, the Board limited the role of non-permit holders in the spawn on kelp fishery to that of assisting with transporting kelp only after the close of the period. By 1993, most permits became permanent and in 1997, 295 people held permanent permits.

The fishery has opened for all years, since 1984, except 1985, 1997, 1998, 2000, and 2001. Actual harvests exceeded the 350,000 lb. guideline by more than 10% in six years and fell short in six. For the three other years in which a fishery occurred, actual harvests were within 10% of the guideline. The two to three year rotation schedule was adhered to in all years except 1987. In 1987, area K-9 was opened after harvest in area K-10 fell short of the harvest guideline; only the western half of area K-9 had been opened in 1986.

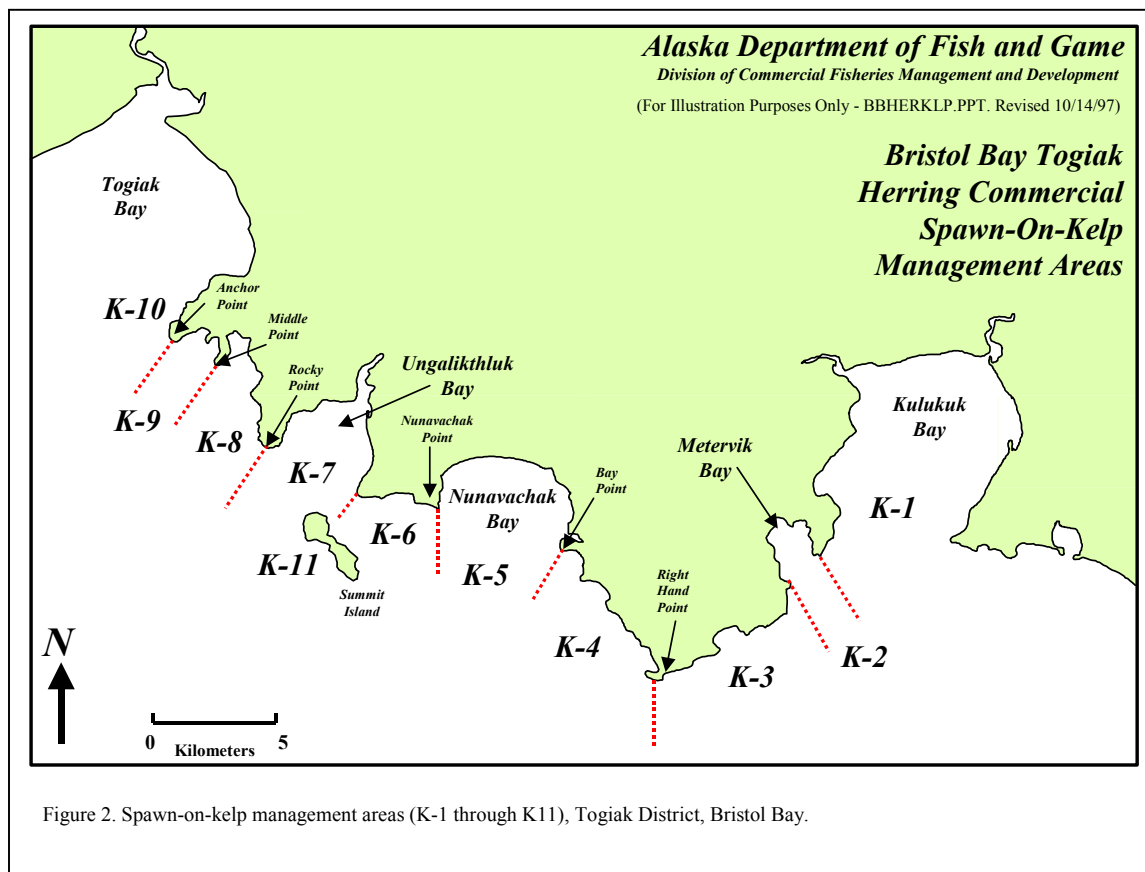


Figure 2. Spawn-on-kelp management areas (K-1 through K11), Togiak District, Bristol Bay.

In 2003, one company registered to purchase a limited amount of spawn on kelp product in the Togiak Herring District. Surveys of kelp were conducted on April 30 and May 2 in units K-3, K-4, K-5, K-8, and K-9. Samples from K-3 in the area from Eagle Bay to Right Hand Point were judged to be of the best quality. The buyer met with ADF&G staff on the morning of May 3 and reported that there was enough marketable kelp available for an opening. Weather conditions had been good for the preceding two weeks but were forecasted to worsen in the near future. Therefore, the opening was set for 11:00 pm, May 3.

There are 287 permit holders for the Togiak spawn on kelp fishery, approximately 62% of which renewed their permits for 2003. Due to the limited amount of spawn on kelp product desired by the buyer and the number of permit holders potentially available to participate in the fishery, the opening was limited to three hours. In 2002, a two-hour opening allowed for a 30-ton harvest at a harvest rate of 220 lbs/person/hour. The opening this year was 1 hour longer and was deemed necessary to make up for reduced permit holder turnout (resulting from the distance between the village of Togiak and the kelping unit) and to account for the increase in market demand.

The total amount of harvested spawn on kelp was smaller than expected (because there was only one processor, the precise information is unavailable due to confidentiality issues.) Thirty-five deliveries were made. The kelp was considered to be of good quality.

The small amount of kelp harvested was likely a result of a number of factors. The most favorable tide for kelping this year was well after dark. Additionally, the tide was relatively high (1.9 feet holdover) for kelp picking so much of the kelp was not exposed. This year had fewer participants due to the distance from Togiak to the open kelp area and the low price offered by the buyer.

## **LITERATURE CITED**

Lebida, R.C. and D.C. Whitmore. 1985. Bering Sea Herring Aerial Survey Manual. Alaska Department of Fish and Game, CFMD, Bristol Bay Data Report 85-2, Anchorage.

Appendix Table 1. Exvessel value of the commercial herring and spawn-on-kelp harvest, in thousands of dollars, Togiak District, 1980-2003.<sup>a</sup>

Year	Herring		Spawn-on-Kelp	Total
	Sac Roe	Food/Bait		
1980	3,055	150	95	3,300
1981	3,988	1	250	4,239
1982	6,070	105	176	6,351
1983	10,450	67	284	10,801
1984	7,178	33	203	7,414
1985	13,696	41	<sup>b</sup>	13,737
1986	8,648	12	187	8,847
1987	8,614	49	166	8,829
1988	14,103	3	346	14,452
1989	4,983	19	448	5,450
1990	6,494	9	360	6,863
1991	6,173	21	383	6,577
1992	8,818	26	254	9,098
1993	5,218	3	268	5,489
1994	9,090	0	212	9,302
1995	16,713	0	362	17,075
1996	14,395	5	510	14,910
1997	4,306	0	<sup>b</sup>	4,306
1998	3,986	0	<sup>b</sup>	3,986
1999	6,211	0	315	6,526
2000	4,000	0	<sup>b</sup>	4,000
2001	3,090	0	<sup>b</sup>	3,090
2002	1,880	0	20	1,900
1983-02 Average	7,902	14	288	8,133
1993-02 Average	6,889	1	281	7,058
2003	2,797	0	<sup>c</sup>	2,797

<sup>a</sup> Exvessel value (value paid to the fisherman) is derived by multiplying price/ton by the commercial harvest. These estimates do not include any postseason adjustments to fishermen from processors and should therefore be treated as minimum estimates.

<sup>b</sup> Fishery not conducted.

<sup>c</sup> Data confidential under Alaska Statute 16.05.815.



Appendix Table 2. Aerial survey estimates of herring biomass and spawn deposition, Togiak District, 1979-2003.

Year	Preseason Forecast <sup>a</sup>	Biomass Estimate	Spawn Estimates	
			Observations	Miles
1979		239,022	52	22
1980		68,686	64	24
1981		158,650	106	40
1982		97,902	103	39
1983		141,782	189	60
1984	106,422	114,880	171	61
1985	81,899	131,400	141	43
1986	86,310	94,700	182	67
1987	61,100	88,400	160	76
1988	54,500	134,717	107	61
1989	80,100	98,965	69	53
1990	56,000	88,105	94	66
1991	55,000	83,329	90	70
1992	60,214	156,955	160	97
1993	148,786	193,847	76	53
1994	142,497	185,454	80	72
1995	149,093	149,093 <sup>b</sup>	70	59
1996	135,585	135,585 <sup>b</sup>	99	73
1997	125,000	144,887	79	59
1998	121,000	121,000 <sup>b</sup>	42	33
1999	90,000	156,183	33	56
2000	130,904	130,904 <sup>b</sup>	71	46
2001	119,818	146,209 <sup>c</sup>	100	57
2002	120,196	120,196 <sup>b</sup>	79	32
<hr/>				
1984-02 Average	101,285	130,253	100	60
1993-02 Average	128,288	148,336	73	54
<hr/>				
2003	126,213	126,213 <sup>b</sup>	42	95

<sup>a</sup> 1993-2003 forecasts based on Age Structured Analysis. Previous years based on age composition, abundance, average growth and mortality rates. Forecasts for Togiak herring not provided prior to 1984.

<sup>b</sup> Inseason biomass estimate precluded by weather conditions. Inseason management used preseason forecast.

<sup>c</sup> Peak biomass estimate was not available during the commercial fishery and the harvest guideline was based on the preseason forecast.

Appendix Table 3. Sac roe herring industry participation, fishing effort and harvest, Togiak District, 1979-2003.

Year	Companies	Daily Processing Capacity <sup>a</sup>	Fishery Dates	Gillnet					Purse Seine					Total Harvest <sup>c</sup>
				Effort <sup>b</sup>	Duration (hrs.)	Harvest <sup>c</sup>	C.P.U.E.	Roe%	Effort <sup>b</sup>	Duration (hrs.)	Harvest <sup>c</sup>	C.P.U.E.	Roe%	
1979	33		5/1-6/1	350	768.0	4,459	0.0	8.6	175	696.0	6,667	0.1	8.6	11,126
1980	27		4/25-5/16	363	384.0	4,150	0.0	8.0-11.0	140	384.0	20,366	0.4	8.0-11.0	24,516
1981 <sup>d</sup>	28		5/2-5/16	106	101.0	2,338	0.2	6.7	83	101.0	10,151	1.2	10.1	12,489
1982	33		5/14-5/24	200	60.0	7,105	0.6	7.4	135	36.0	14,716	3.0	9.5	21,821
1983	23		5/3-5/11	250	42.0	5,344	0.5	6.9	150	14.0	21,442	10.2	9.3	26,786
1984	25		5/18-5/21	300	35.0	4,934	0.5	8.4	196	11.0	14,485	6.7	10.2	19,419
1985	23		5/23-5/25	302	11.0	4,482	1.3	7.4	155	3.0	21,330	45.9	10.0	25,812
1986	23		5/14-5/15	209	10.0	3,448	1.6	8.8	209	1.0	12,828	61.4	9.9	16,276
1987	18		4/27-5/6	148	36.0	2,685	0.5	8.6	111	5.5	12,845	21.0	8.9	15,530
1988	22		5/17	300	4.0	3,695	3.1	8.3	239	0.5	10,472	87.6	10.9	14,167
1989	19		5/9-5/14	320	5.0	2,844	1.8	7.8	310	3.0	9,415	10.1	8.5	12,259
1990	16	3,100	5/8-5/20	277	66.0	3,072	0.2	9.0	221	3.0	9,158	13.8	9.7	12,230
1991	16	3,350	5/10-5/17	170	14.0	3,182	1.3	8.5	200	3.0	11,788	19.6	10.0	14,970
1992	18	3,700	5/20-5/27	274	25.5	5,030	0.7	8.8	301	0.3	20,778	230.1	9.2	25,808
1993	12	2,500	4/27-5/9	75	144.5	3,564	0.3	10.1	140	33.8	14,392	3.0	9.6	17,956
1994	16	3,300	5/11-5/20	146	76.0	7,462	0.7	12.0	240	4.6	22,853	20.7	9.4	30,315
1995	22	4,350	5/7-5/15	250	33.5	6,995	0.8	12.0	254	12.2	19,737	6.4	10.1	26,732
1996	19	4,850	5/3-5/8	461	18.0	6,863	0.8	11.1	268	2.4	18,008	27.8	9.0	24,871
1997	18	4,200	5/2-5/6	336	24.0	5,164	0.6	11.8	231	6.4	18,649	12.6	9.4	23,813
1998	15	2,475	4/29-5/10	152	46.0	5,952	0.9	12.5	123	16.5	16,824	8.3	9.6	22,776
1999	12	2,400	5/18-5/26	171	28.0	4,858	1.0	11.5	96	4.7	15,020	33.3	9.2	19,878
2000	12	2,100	5/6-5/14	227	67	5,442	0.36	10.56	90	15.75	14,632	10.32	10.13	20,074
2001	11	2255	5/6-5/13	96	84	6,481	0.8	10.64	64	26.0	15,320	9.2	9.2	21,801
2002	8	1,920	5/3-5/13	82	102	5,216	0.62	10.9	37	57.5	11,550	5.43	9.3	17,089
1983-02 Ave.	17	3,115		227	44	4,836	0.9	9.8	182	11	15,576	32.2	9.6	20,428
1996-02 Ave.	14	2,886		218	52.7	5,711	0.7	11.3	130	18	15,715	15.3	9.4	21,472
2003	7	1,920	4/25-5/7	75	142.0	6,505	0.6	10.9	35	110.17	14,312	3.7	8.9	20,817

<sup>a</sup> Number of tons per day based on companies registered.

<sup>b</sup> Peak aerial survey count.

<sup>c</sup> Harvest total does not include deadloss or test fish harvest.

<sup>d</sup> Fishery managed by emergency order from 1981 to present.

Appendix Table 4. Exploitation of Togiak herring stock, 1980-2003.

Year	Biomass Estimate <sup>a</sup> (short tons)	S-O-K Herring Equivalent	Dutch Harbor Food/Bait	Sac Roe			Total Harvest	Exploitation Rate
				Gillnet	Purse Seine <sup>b</sup>	Waste		
1980	68,686			4,150	20,366		24,516	35.7%
1981	158,650			2,338	10,151		12,489	7.9%
1982	97,902			7,105	14,716		21,821	22.3%
1983	141,782			5,344	21,442		26,786	18.9%
1984	114,880	1,552		4,934	14,485		19,419	18.3%
1985	131,400	0		4,482	21,330		25,812	19.6%
1986	94,700	1,446		3,448	12,828		16,276	18.7%
1987	88,400	1,309		2,685	12,845		15,530	19.0%
1988	134,717	1,782	2,004	3,695	10,472		14,167	13.3%
1989	98,965	2,499	3,081	2,844	9,415		12,259	18.0%
1990	88,105	1,617	820	3,072	9,158		12,230	16.6%
1991	83,329	1,310	1,325	3,182	11,788		14,970	21.1%
1992	156,955	1,482	1,949	5,030	20,778		25,808	18.6%
1993	193,847	1,481	2,790	3,564	14,392		17,956	11.5%
1994	185,454	1,134	3,349	7,462	22,853		30,315	18.8%
1995	149,093	996	1,748	6,995	19,737		26,732	19.8%
1996	135,585	1,899	2,239	6,863	18,008		24,871	21.4%
1997	144,887	0	1,950	5,164	18,299	350	23,813	17.8%
1998	121,000	0	1,994	5,952	16,424	400	22,776	20.5%
1999	156,183	1,605	2,398	4,858	14,799	221	19,878	15.3%
2000	130,904	0	2,014	5,464	14,857	100	20,421	17.1%
2001	119,818	0	1,439	6,481	15,630	219	22,330	19.8%
2002	120,196	260	2,846	5,216	11,793	40	17,049	16.8%
1983-02 Ave.	129,510	1,072	2,130	4,837	15,567		20,470	18.0%
1993-02 Ave.	145,697	738	2,277	5,802	16,679		22,614	17.9%
2003	126,213	<sup>c</sup>	1,487 <sup>d</sup>	6,505	14,778	380	21,663	18.3%

<sup>a</sup> Preseason forecast unless inseason peak biomass estimate exceeded preseason forecast.<sup>b</sup> Includes test fish harvest.<sup>c</sup> Data confidential under Alaska Statute 16.05.815.<sup>d</sup> Information from the 2003 Dutch Harbor Herring Food & Bait Fishery Summary.

Appendix Table 5. Guideline and actual harvests of sac roe herring (tons) and spawn-on-kelp (lbs), Togiak District, 1984-2003.

Year	Gillnet Sac Roe			Purse Seine Sac Roe			Spawn-on-Kelp		
	Guideline <sup>a</sup>	Actual	Difference <sup>b</sup>	Guideline <sup>a</sup>	Actual <sup>b</sup>	Difference <sup>c</sup>	Guideline <sup>a</sup>	Actual	Difference <sup>c</sup>
1984							350,000	406,586	16%
1985							350,000	<sup>d</sup>	
1986							350,000	374,142	7%
1987							350,000	307,307	-12%
1988	5,647	3,695	-35%	16,943	10,472	-38%	350,000	489,320	40%
1989	3,376	2,844	-16%	10,128	9,415	-7%	350,000	559,780	60%
1990	2,993	3,072	3%	8,980	9,158	2%	350,000	413,844	18%
1991	3,143	3,182	1%	9,429	11,788	25%	350,000	348,357	0%
1992	5,662	5,030	-11%	16,985	20,778	22%	350,000	363,600	4%
1993	6,570	3,564	-46%	19,709	14,392	-27%	350,000	383,000	9%
1994	6,277	7,462	19%	18,832	22,853	21%	350,000	308,400	-12%
1995	6,582	6,995	6%	19,747	19,737	0%	350,000	281,600	-20%
1996	5,956	6,863	15%	17,868	18,008	1%	350,000	455,800	30%
1997	5,464	5,164	-5%	16,391	18,649	14%	350,000	<sup>d</sup>	
1998	5,280	5,952	13%	15,840	16,824	6%	350,000	<sup>d</sup>	
1999	6,914	4,858	-30%	20,741	15,020	-28%	350,000	419,563	20%
2000	5,738	5,464	-5%	17,215	14,857	-14%	350,000	<sup>d</sup>	
2001	6,268	6,481	3%	14,624	15,849	8%	350,000	<sup>d</sup>	
2002	6,288	5,216	-17%	14,673	11,833	-19%	350,000	67,793	-81%
1988-02 Average	5,477	5,056	-7%	15,874	15,309	-2%	350,000	369,935	6%
2003	6,624	6,505	-2%	15,457	15,158	-2%	350,000	<sup>e</sup>	

<sup>a</sup> Harvest guideline derived from inseason biomass estimate when available, or preseason forecast when weather precluded an inseason estimate.

<sup>b</sup> Includes deadloss and test fish harvest.

<sup>c</sup> Actual minus guideline divided by guideline.

<sup>d</sup> No fishery conducted

<sup>e</sup> Data confidential under Alaska Statute 16.05.815.

Appendix Table 6. Herring spawn-on-kelp industry participation, fishing effort, area and harvest, Togiak District, 1979-2003.

Year	Companies	Fishery Dates	Hours	Effort <sup>a</sup>	Area	Total Harvest in pounds	Herring Equivalent (in tons)	Openings	Average roe %
1979	16	5/4-5/23		100	Togiak District	414,727			0.1
1980 <sup>b</sup>	21	5/2-5/13		78	K 3 - K 10	189,662			9.2
1981	7	5/5-5/13		108	K 3 - K 9	378,207			9.1
1982	8	5/21-5/23	39.0	214	K 3 - K 9	234,924		2	8.8
1983	4	5/5-5/7	52.0	125	K 3 - K 9	270,866		3	8.9
1984 <sup>c</sup>	6	5/21-5/24	16.0	330	K 4, K 9	406,586	1,552	3	9.8
1985		no fishery							9.6
1986	6	5/18-5/21	21.0	204	K 7, K 8, K 9	374,142	1,446	4	9.7
1987	5	4/29-5/4	6.6	187	K 9, K 10	307,307	1,309	5	8.8
1988	10	5/20	6.0	259	K 4, K 8	489,320	1,782	1	10.3
1989	11	5/14	4.0	487	K 9	559,780	2,499	1	8.3
1990	7	5/11	3.0	481	K 8	413,844	1,617	1	9.5
1991	7	5/13	2.5	532	K 4	348,357	1,310	1	9.7
1992	5	5/23	3.3	386	K 9	363,600	1,482	2	9.1
1993	2	5/1-5/2	7.0	173	K 8	383,000	1,481	2	9.7
1994	3	5/13-5/14	7.5	204	K 5	308,400	1,134	2	10.0
1995	5	5/11-5/14	14.5	188	K 2, K 3	281,600	996	3	10.6
1996	3	5/9-5/10	12.0	200	K 8, K 9	455,800	1,899	2	9.6
1997		no fishery							
1998		no fishery							
1999	1	5/23	8.0	130	K 9	419,563	1,605	2	9.8
2000		no fishery							
2001		no fishery							
2002	1	5/14	2.0	50	K 9	67,793	260	1	9.8
1993-02 Ave.	3		8.5	158		319,359	1,229	2	9.9
1998-02 Ave.	1		5.0	90		243,678	933	2	9.8
2003	1	5/3-5/4	3.0	35	K-3	<sup>d</sup>	<sup>d</sup>	1	<sup>d</sup>

<sup>a</sup> 1978 - 1989 and 1992 - 1996, number of permits fished based on fish tickets. 1990 and 1991, peak aerial survey count.

<sup>b</sup> Management plan adopted by Board of Fisheries in December, 1979 designating 10 kelp areas, and requiring emergency order closure when 10% of the standing biomass of kelp was harvested.

<sup>c</sup> Management plan adopted by Board of Fisheries setting 350,000 lb. harvest guideline, specifying 2 to 3 year rotation, and including spawn-on-kelp herring equivalent in exploitation rate.

<sup>d</sup> Data confidential under Alaska Statute 16.05.815

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